International Science and Technology
Emerging Trends in Government Policies and Expenditures

Nations in all parts of the world place sustained economic growth and job creation at the top of their list of national priorities. These nations are implementing science and technology (S&T) policies to develop cutting-edge domestic industries and attract the engines of economic expansion to their shores.

Advances in technology—through improvements in capital and labor productivity, and the introduction of new products, services and systems—are responsible for more than half of the economic growth of the United States. Our trading partners explicitly recognize the connection between technology and economic growth in their science and technology policy visions.

Increasing Foreign Investment in Non-Defense S&T

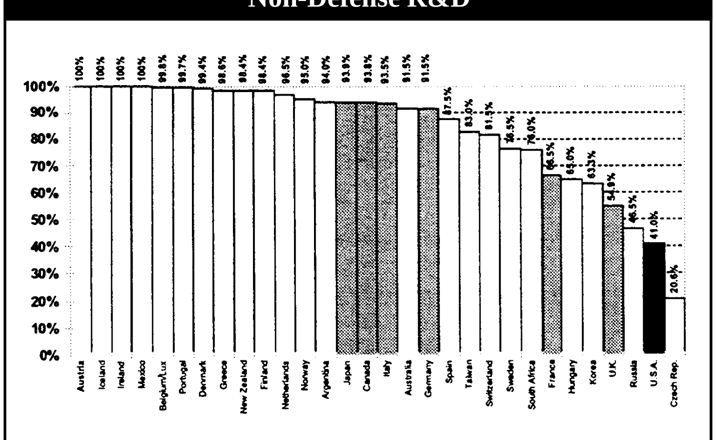
In the period following World War II, the United States led the world economy through investments in basic science, commercial spin-offs from government mission R&D, and technological growth through more recent government-industry partnerships. As our trading partners have increased in power and technological sophistication, they too have drawn from the U.S. science base and technology spin-offs. They have supplemented U.S. and other foreign science and technology with their own research and development expenditures, most of which are focused on the civilian sector.

- European nations are accelerating investment in commercial technologies through national programs and through European Union (EU) joint R&D initiatives.
- Japan plans to double the government science and technology budget by the year 2000.
- China is planning to triple its investment in R&D by 2000, targeting computers, software, telecommunications, pharmaceuticals and infrastructure.
- The Republic of Korea has considerably boosted its R&D efforts in key technology areas and is actively acquiring foreign technology.
- The newly emerging Asian economies are planning to significantly increase the percent of their GDP devoted to science and technology.

Non-Defense Government R&D

Defense applications have accounted for the dominant share of the United States' government research and development expenditures. At present, the United States ranks 29th among the advanced industrial nations—and behind all other G7 countries—in the percentage of government R&D applied to non-defense activities.†

U.S. Ranked 29th in Percent of Government Non-Defense R&D

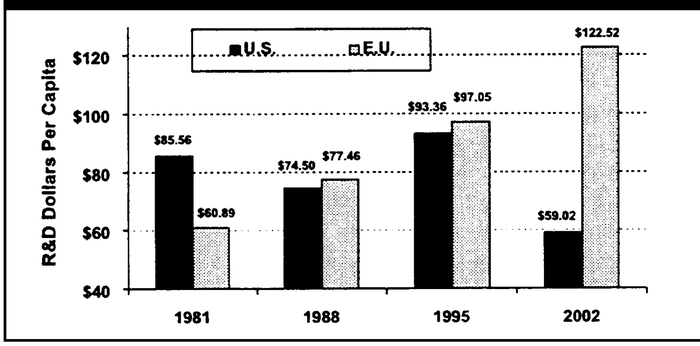


A Global Shift in R&D

Foreign government non-defense R&D is increasing dramatically at a time when some forecast that the U.S. government investment in civilian R&D will decrease. If these forecasts are realized, U.S. government spending per capita on non-defense R&D would fall from nearly 50 percent above our major competitors in 1981 to more than 50 percent below them in 2002.*

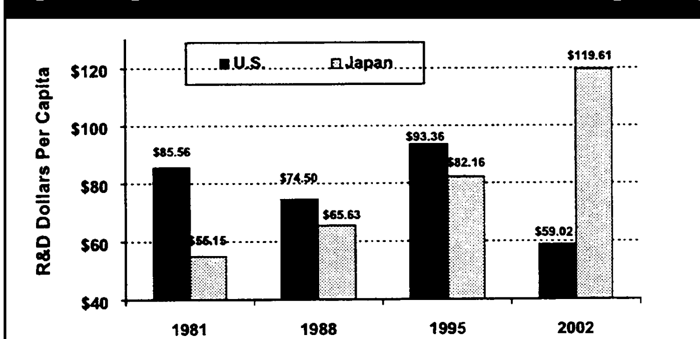
- In 1981, U.S. government non-defense R&D per capita was 141 percent that of the EU; by 1995 it was 96 percent. By 2002, some forecasts would reduce it further, to approximately 50 percent of per capita EU spending.*

EU Surpasses, then Doubles U.S. Non-Defense Spending



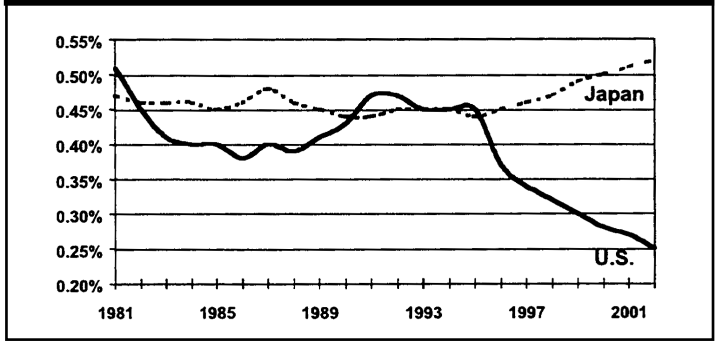
- In 1981, U.S. government non-defense R&D per capita was 155 percent of Japan; by 1995 it was 114 percent. By 2002, some forecasts would reduce it to less than half (approximately 49 percent) of Japanese per capita spending.*

Japan Surpasses, then Doubles U.S. Non-Defense Spending



• At the present time, U.S. and Japanese government non-defense R&D are each 0.45 percent of their respective GDP (i.e., the U.S. non-defense budget was $33 billion in 1995 while Japan's was over $13 billion in current purchasing power parity U.S. dollars).^ By 2002, Japan plans to increase its civilian R&D to 0.5 percent of GDP, while that of the U.S. could fall to 0.25 percent of GDP according to some forecasts.*

U.S. Non-Defense R&D/GDP Falls, Japan's Rises



Additional Japanese Science and Technology Expenditures

The estimate for Japanese government science and technology expenditures for 1995 (¥2.49 trillion) used in the comparisons above is taken from the Japanese Central Government's initial science and technology budget. However, it neglects several significant sources of government support for Japanese science and technology. The combined science and technology-related portion of the supplementary budget and R&D expenditures under the Fiscal Investment and Loan Program amounted to ¥1.76 trillion in 1995, adding approximately 70 percent more to the initial budget. This suggests many international comparisons of Japanese science and technology typically underestimate Japanese governmental contributions to the creation of a business climate conducive to innovation.

†Source: World CompetitivenessReport--1995, the World Economic Forum, Geneva, Switzerland, 15th Edition.

**Foreign amounts are expressed in constant 1987 purchasing power parity dollars from NSF unpublished 1980-92 data. EU projections to year 2002 use a regression forecast based on unpublished NSF EU budget figures for 1980-92. All EU data is for current membership. Japan projections are based on 1995 Japan MITI announcement that it would double the growth rate of its R&D budget with the aim of doubling the budget by the turn of the century.*

U.S. 1981-1995 amounts are expressed in 1987 dollars and are derived from NSF Federal R&D Funding by Budget Function, FY 93-95. The 1996-2002 projections are based on AAAS preliminary data derived from the 1995 Congressional Budget Resolution and assume a 3% inflation. Population projections are based on 1980-92 growth trends.

U.S. GDP projections are regressions based on 1980-94 data sourced from the Economic Report of the President, 1995. Japan GDP projections assume Japan maintains its 1980-91 average growth rate.

^Source: OECD "Main S&T Indications," 1995.

France, Germany, and the United Kingdom

European Nations Speed the Development of Commercial Technologies

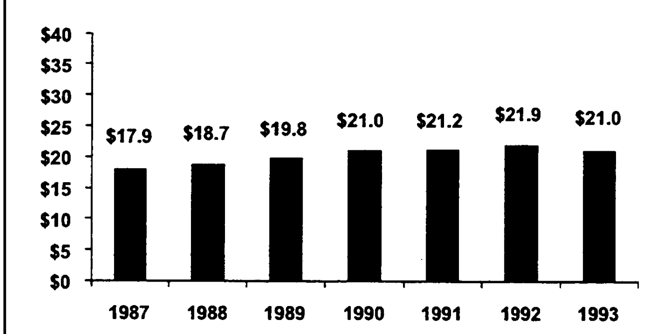
European governments are investing billions of dollars in national programs to increase their technological competitiveness. Together, France, Germany, and the United Kingdom (U.K.) invested more than $28 billion in 1993 on public sector non-defense R&D compared to $29 billion ($30 billion in 1994) for the United States. Germany's non-defense R&D investment, per unit of GDP, exceeds that of the United States, while French investments equal U.S. spending on a GDP basis.

European countries invest heavily in technology development to strengthen their global competitive position. France, Germany, and Britain each sponsor major programs to link public and industrial R&D. And all three nations provide financing for pre-competitive technologies and other forms of technology assistance for private firms, in some cases modeling their efforts on programs started in the United States.

France

France maintains a strong commitment to civilian R&D in the face of tremendous budgetary pressure. Between 1989 and 1993, while the French defense R&D budget fell by 5.1 percent (unadjusted for inflation), funding for government non-defense R&D increased by 15.5 percent to $9.1 billion in current purchasing power parity dollars.*

The French government finances large scientific and industrial development programs designed to produce breakthroughs in health (human genome and AIDS research), biotechnology, microelectronics, nuclear energy, and environmental sciences. Large-scale programs, including some aspects of the space program, receive about $1.4 billion.



Total France R&D Expenditures
*Billions of Constant 1987 Dollars**

*Conversions of foreign currencies to U.S. dollars are calculated with OECD purchasing power parity exchange rates. Source: National Science Foundation.

The French government employs several mechanisms to promote the development of industrial technologies. These include:

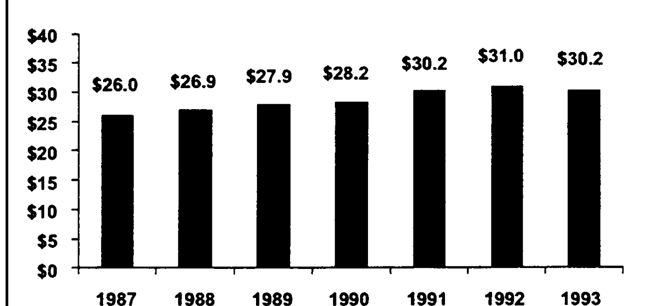
- Civilian R&E tax credit (1993 cost of $800 million);
- Cooperative government/industry projects to develop generic technologies;
- *"Technological Leap" Program* finances demonstrations of pre-competitive industrial technologies on a cost-shared basis with industrial partners;
- "Large innovation projects" target technology development in priority sectors (advanced materials, pharmaceutical raw materials, intelligent manufacturing, transport, and others);
- Large inter-ministerial technology development programs (clean vehicles, ultra-clean food processing, water treatment, and road safety).

On a regional level, the French government sponsors the *ANVAR Program*, a network of regional technology transfer centers to promote public-private technology transfer and diffuse R&D away from the Paris region.

Germany

Germany leads Europe in non-defense government R&D investments with Federal and state expenditures of $13.7 billion in current purchasing power parity dollars, a 40.2 percent increase between 1989 and 1993 in current dollars.* Twenty percent of Germany's government expenditures go to basic research. German defense R&D fell 16.3 percent from 1989 to $3.9 billion in 1993. German R&D goals include:

- supporting selected high-technology sectors,
- building a scientific and technological infrastructure in the eastern areas, and
- promoting basic research.



Total Germany R&D Expenditures
*Billions of Constant 1987 Dollars**

*Conversions of foreign currencies to U.S. dollars are calculated with OECD purchasing power parity exchange rates. Source: National Science Foundation.

Germany continued—

Germany actively supports the development of pre-competitive technologies to broaden the scientific and technological base on which commercial R&D depends. Government-supported institutions conduct several of these programs. In 1992, the German government spent $1.2 billion on multi-year research in:

- ◆ Cross-sectoral areas, such as information, biotechnology, materials, and chemicals.
- ◆ Priority plans and initiatives, such as neuro-informatics, bio-informatics, nano-electronics, microsystems technology, biological safety, and environmental biology.

The German government also finances technology research through the Fraunhofer Institute, an $800 million per year non-profit institution that performs contract research for government and industry. Fraunhofer is active in several technology areas. It has recently begun to tap U.S. technological expertise and helps build markets for German equipment in the United States.

In the east, Germany has promoted the development of a commercial technology infrastructure by establishing industrial R&D advisory agencies and demonstration centers, and providing financial support for new technology-based companies and for expanded R&D staff at established firms. On a nationwide basis, the government provides support for applications-oriented scientific research institutions, technology centers, and technology transfer activities between university and industry.

United Kingdom

At $4.7 billion in current purchasing power parity dollars in 1993, the U.K. non-defense R&D budget grew 5.8 percent since 1989(an annual average of 1.6 percent).* The British government currently invests about $5 billion in non-defense R&D. Thirty percent of total R&D (defense and non-defense) goes to basic research, 52 percent to support government missions, and 12 percent for technology programs.

The U.K. places strong emphasis on linking public and industrial R&D. Under the *"Technology Foresight"* and *"Forward Look"* frameworks, the government regularly projects science, engineering, and technology policy for a five to ten-year period. A National Technology Foresight Program brings scientists and industrialists together to assess significant emerging technologies and market opportunities.

The U.K. government also directly supports several public/private research partnerships:

- ◆ The *LINK Program* partners with private companies and research institutions to encourage pre-competitive R&D for early-stage technologies. The government has invested over $350 million — providing up to 50 percent of the funding for these projects.
- ◆ *The Advanced Technology Programs (ATPs)* speed the development of key technologies, including robotics, superconductivity, under-sea technology, and advanced information technologies. The U.K. has devoted several hundred million dollars to the ATPs.
- ◆ *SPUR (Support for Products Under Research)* and *SMART (Small Firms Merit Award for Research and Technology)* assist small companies in moving products from research to commercialization. The British government also sponsors other initiatives to increase the access of small and medium-sized firms to new technologies.

** Source: OECD "Main Science and Technology Indicators," 1995.*

European Union, EUREKA, ESA

Fourth Framework Invests Approximately $3.4 Billion Per Year in R&D

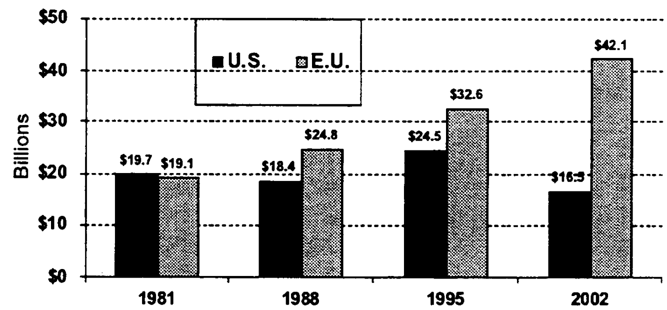
European nations continue to invest heavily in joint R&D organizations to leverage national spending and to take advantage of the synergies that cooperation offers among countries in close geographic and cultural proximity. These joint activities are increasing in size and scope.

The European Union and the Fourth Framework

The *European Union (EU)* is in the midst of an $18 billion five-year effort to increase European competitiveness and create jobs by strengthening the region's science and technology base. The EU's Fourth Framework program is a blueprint for R&D spending during 1994-1998, and targets high technology sectors. The Fourth Framework is spending approximately $3.4 billion per year.

These investments are being made in cost-shared partnerships with major European technology companies that are already global competitors. While Europe designed the Fourth Framework to address barriers that hamper innovation in some areas, a successful program could help Europe compete effectively with the United States in lucrative high-technology markets of the future.

July 1995 Budget Resolution Reduces U.S. Government Non-Defense R&D Funding Substantially Below that of the European Union
Constant 1987 Dollars *



◆ The major goals of the EU's Fourth Framework are to: promote economic growth and employment through technology; assist industry in developing new products; exploit research findings; facilitate the training and mobility of researchers; and increase global economic cooperation with non-member countries.

◆ The Fourth Framework's five-year budget, recently increased to accommodate the admission of Austria, Finland, and Sweden to the EU, is $17.2 billion. Investments focus on the following areas:

• Research, Technological Development, and Demonstration Programs	$15 billion
• Stimulation of Training and Mobility of Researchers	$1 billion
• Cooperation with Third Countries and International Organizations	$756 million
• Dissemination and Optimization of Results	$462 million

◆ The largest Fourth Framework activity — Research, Technological Development, and Demonstration Programs — targets:

• Information & Communication Technologies	$ 4.8 billion
• Energy	$ 3.2 billion
• Industrial Technologies	$ 2.8 billion
• Life Sciences and Technologies	$ 2.2 billion
• Environment	$ 1.5 billion
• Transport	$257 million
• Targeted Socio-Economic Research	$148 million

◆ The European Commission has recently recommended $917 million in additional spending for FY 1997-1998 for five special technology task forces:

• Environmental Technologies for Water and Nuclear Safety	$249 million
• Aeronautics	$210 million
• Car of the Future	$170 million
• Multimedia Software	$165 million
• Intermodal Transport	$118 million

The European Space Agency

The *European Space Agency (ESA)*, a 14-member organization with an annual budget of $3.2 billion, promotes technology development and scientific research in space. ESA has helped Europe develop an independent launch and space technology capability to compete with U.S. firms. Member countries use ESA as a mechanism to develop their national aerospace industries. France has been ESA's largest contributor and beneficiary, though Italy, Germany, and Britain have each derived substantial benefits. Although ESA collaborates with NASA on scientific missions, the two agencies do not share technologies.

Almost half of ESA's $3.2 billion FY1996 budget will be spent on launchers, microgravity research, and telecommunications, areas with direct commercial significance.

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EUREKA

EUREKA is a 24-member "bottom-up" mechanism to increase European competitiveness in R&D-related fields and high technology markets. Launched in 1985 as a response to the U.S. Strategic Defense Initiative, EUREKA coordinates and sponsors joint research projects in advanced technology proposed by firms within the member countries. As of November 1995, EUREKA has sponsored 719 ongoing projects with 3,612 participants, and has spent $13.3 billion. Both public and private sources fund projects.

EUREKA members include the 15 EU members, plus the Czech Republic, Hungary, Iceland, Norway, Poland, the Russian Federation, Switzerland, Slovenia, and Turkey. Of 3,612 participants in ongoing projects, 2,418 are companies, 1,037 institutes, and 157 other organizations.

**EU amounts are expressed in constant 1987 purchasing power parity dollars with projections to 2002 using a regression forecast based on unpublished NSF EU budget figures for 1980-92. All EU data is for current membership. U.S. 1981-1995 amounts are expressed in 1987 dollars and are derived from NSF Federal R&D Funding by Budget Function, FY 93-95. The 1996-2002 projections are based on AAAS preliminary data derived from the 1995 Congressional Budget Resolution, and assume a 3% inflation rate.*

JAPAN

Creative Science and Technology To Drive Competitiveness

To remain one of the most competitive nations in the world, Japan will create new markets by providing products and services incorporating leading-edge technology and by finding new applications for existing technology. Thus, Japan must strive to "become a nation based on creative science and technology." Japan is the world's technological powerhouse in many areas such as electronics and manufacturing, and seeks to expand its reach into other key technology and market drivers, such as information technology and advanced materials.

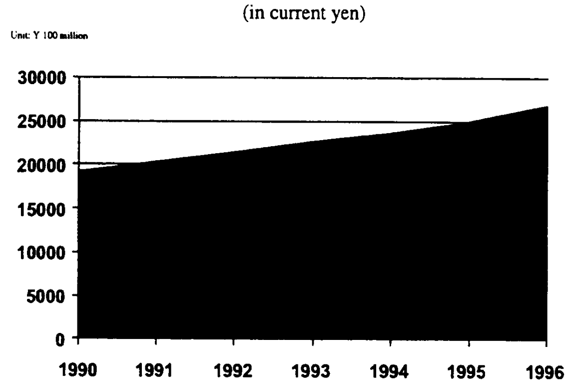
As a result, Japanese government funding for science and technology is rising sharply. Japan's FY 1996 budget boosts investment by 6.9 percent to $26.7 billion, the highest percentage increase since 1979. This increase demonstrates Japan's firm commitment to science and technology as an engine of economic growth because it comes amid overall budget cuts. The momentum for reaching Japan's goal of doubling the government budget for science and technology by the year 2000 is steadily growing within the ministries and the Diet.

CONTINUING A COMPREHENSIVE SCIENCE AND TECHNOLOGY POLICY

→ Japan pursues an active and comprehensive science and technology policy involving the national government, regional and local governments, public corporations and private industry. This policy seeks to:

- -Increase R&D investment
- -Improve the R&D infrastructure
- -Stimulate research and creativity
- -Intensify international science and technology activities
- -Promote science and technology locally
- -Ensure an adequate base of scientific and technological personnel

The Japanese Central Government's Initial S&T Budget (in current yen)



→ The Japanese government continues to increase R&D funding to compensate for the decrease in R&D spending by the private sector over the past few years. The private sector looks to, and depends upon, the government to help finance and coordinate R&D in key emerging technology areas and to support the science and technology infrastructure. The Japanese government has funded hundreds of R&D projects in the last four years in fields such as advanced materials, information technologies, and electronics.

→ Japan traditionally has been weak in basic research and has relied heavily on foreign sources of technology. Japan will continue to monitor and utilize U.S. and other foreign technology. For example, Japanese companies maintain 224 R&D facilities in the United States — more than any other country. Japanese-funded R&D in the United States has grown rapidly, increasing from $307 million in 1987 to $1.8 billion in 1993.

→ However, to correct this weakness, Japan is increasing funding for basic research and experimenting with new methods to encourage creativity. Increased support for basic research seeks to strengthen Japan's capability to develop for itself the knowledge necessary for technological innovation, and the creation of new industries and markets

RESEARCH AND DEVELOPMENT TRENDS

→ Japan's government R&D funding is increasing at a higher rate than spending in the overall budget. The Ministry of International Trade and Industry's (MITI) Agency for Industrial Science and Technology (AIST) has proposed an FY1996 R&D budget of $1.4 billion, an increase of 7.5 percent from FY 1995. This increase is significant, given that the total Japanese government budget for FY 1996 will increase only by 5.8 percent. In FY 1996, AIST will initiate new programs to support research at national research institutes and private sector R&D activities that leads to the creation of new industries.

→ The Japanese government's support for R&D goes beyond direct funding from its general budget. The government continues to support science and technology through the Fiscal Investment and Loan Program (FILP), which provides loans to public corporations, some of which undertake science and technology-related activities. It also implements the following tax measures and programs to encourage the private sector to increase R&D investments:

- -Tax deductions on experimental and research expenses
- -Exemptions under *The Tax Program for Promoting R&D of Basic Technologies*
- -*Cooperative Development for Industrial Technology* for the development and application of new technologies
- -Credit guarantee programs

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THE FUTURE

The Japanese government has made a long-term commitment to support and nurture science and technology. It is demonstrating this commitment through many new efforts to stimulate creativity .

For example, the Ministry of Education established *Centers of Excellence,* designed to bring together leading scientists and promising young researchers from around the world to collaborate on highly advanced areas of research.

→ In FY 1995, the Ministry of Education strengthened the Centers by funding research, facilities and equipment, foreign research fellowships and international symposia. Nagoya University's ultra-parallel optoelectronics research program is one such Center of Excellence.

→ Japan's government and industry are riding together onto the information superhighway of the 21st Century. In 1996, MITI will launch a digital academy program to train personnel developing multimedia software. Government and business will cooperate to build the educational environment needed to train content developers. In March 1996, in conjunction with local governments, MITI will open multimedia labs throughout Japan to help small companies and regional economies develop multimedia software. There are many other major information technology initiatives ranging from electronic commerce (CALS) to the Inter-Ministerial Network.

PEOPLE'S REPUBLIC OF CHINA
China to Triple its R&D Investment

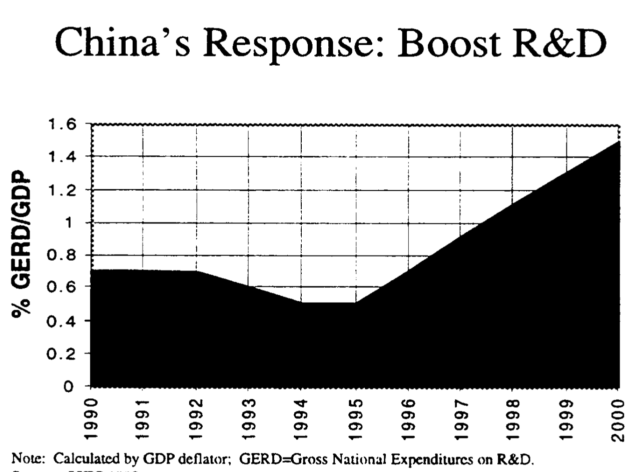
The People's Republic of China is the world's seventh largest economy, with a GDP of $783.7 billion in 1994. Through rapid economic expansion and foreign direct investment, it is poised to become an economic powerhouse. It is targeting industries such as computers, software, telecommunications and pharmaceuticals, and plans to invest over $250 billion in the next five years in the infrastructure necessary to fuel economic growth.

China recognizes it must enhance its technological capabilities to reach its economic goals. It is investing heavily in science and technology to ensure its competitiveness in global markets well into the next century. It is also placing a high priority on acquiring foreign technology to accelerate this process.

CHINA'S STRATEGIC OBJECTIVES

→ China plans to triple its expenditures on science and technology by the year 2000. In its new national economic plan, China's goal is to increase the percentage of GDP invested in research from .5% to 1.5% by the next century. (A comparable increase of one percent of GDP by the United States would cost $70 billion.) This reverses a five-year trend of declining technological research and investments.

→ During the next five years, China will continue to acquire foreign technologies and know-how from advanced nations to strengthen its technological infrastructure and develop basic industries. In l995, technology imports accounted for 10 percent of total imports, a significant jump from 3.5 percent in l994. The value of technology imports was $13 billion, an increase of 217 percent over the previous year.



Note: Calculated by GDP deflator; GERD=Gross National Expenditures on R&D.
Source: SSTC 1995

→ China's technology policies are to diffuse foreign technology and to encourage indigenous development of emerging technologies. These policies will discourage the acquisition of equipment and turn-key plants that have little effect on the nation's ability to develop its technological capabilities.

→ The economic impact of integrating technology policy with economic development plans could be substantial. By maximizing its return on basic industries and creating an infrastructure for emerging technologies, China may be able to maintain its extraordinary annual GDP growth rate of 10-11% well into the next century.

A STRATEGY FOR GLOBAL COMPETITIVENESS

After surveying the world's scientific, technological, and economic trends, China's policy makers devised a strategy for competitiveness in global markets. They have established interlocking policies for technology, industry, and foreign trade to ensure that the development and acquisition of advanced technology serves national economic goals:

→ Boost China's economic performance and increase productivity in five core industries:

-automobiles
-construction materials
-information technologies
-industrial automation
-energy (conservation and alternative sources)

→ Redesign the national system of industrial ministries and state-owned enterprises to form a modern enterprise system. Three hundred key enterprises have been selected for expansion and restructuring by the year 2000. Each of these corporations will have research units integrated within their operational structure, closing the gap between ministry-based R&D and manufacturing enterprises, and reducing the time from R&D to commercialization.

→ Enhance industry's technological capabilities. The Chinese Academy of Sciences' five-year "Industry-Academic Research Plan" lists 100 projects to commercialize technology. The Academy will establish a network to involve 100 key state enterprises being converted to publicly owned corporations.

→ Strengthen the technological infrastructure. In l992, China borrowed $14 million from the World Bank to establish 55 *State Key Laboratories* for basic research and 14 national *Engineering and Research Centers* (ERC). These institutions will transfer basic research results to industry and provide a manufacturing environment for developing technologies that serve national industrial goals. It developed these centers by carefully studying foreign technology programs such as America's Advanced Technology Program.

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MAJOR RESEARCH PROGRAMS

China's major research programs include:

→ *Spark Program*: Diffusion of advanced agricultural techniques.

→ *Key Technologies Program*: Support for research in the natural sciences.

→ *The 863 Program*: Support for basic research in emerging advanced industrial technologies.

→ *Torch Program*: Support for applied research and commercialization of 863 Program results.

CHINA'S KEY TECHNOLOGIES

China has targeted emerging technologies where it has strong basic science capabilities, where an emerging technology cuts across industrial sectors, and/or where an application supports China's economic development goals. It believes these seven technologies will help modernize state-owned enterprises and fuel innovation in the next century:

-aerospace
-lasers
-advanced materials
-microelectronics
-biotechnology
-information technologies
-industrial automation

These technologies target areas of U.S. strength. China's emphasis on technology transfer will result in many initiatives and incentives for acquiring these technologies.

Republic of Korea

Over $334 Million Invested in Strategic Industrial Technologies in 1995

Korea is betting that a continued emphasis on technological innovation and a substantial investment in R&D will enable it to develop a high-technology industrial base on par with the major industrialized countries. It is preparing for an era in which it sees globalization dominating every field of human activity, including science and technology.

Korea's is one of the world's most powerful competitors. Korea is the world's largest producer of DRAMS, and among the top producers of automobiles, ships, and consumer electronics. It currently has over $500 million invested in R&D projects to maintain and enhance its competitive position.

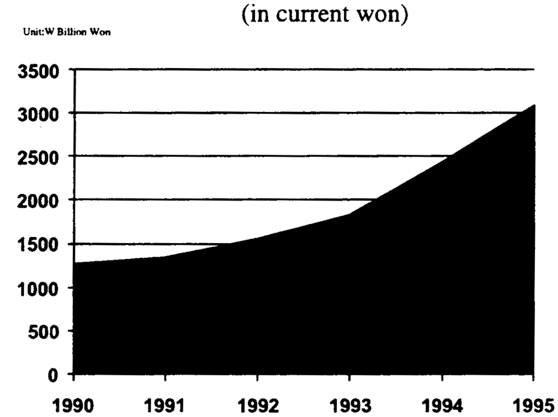
Despite its commercial success, Korea must still seek foreign technology and international partnerships if it is to meet its goal of joining the ranks of the advanced countries. While its production and manufacturing technology is on par with many advanced nations, it still lags behind in many other areas. Therefore, in addition to cooperation with foreign companies, it is stressing technology transfers through academic cooperation, international research projects, and other international forums.

R&D Expenditures

The Korean Government significantly boosted R&D spending to develop key technologies that will increase its competitiveness in global markets. The Korean Government's 1996 non-defense R&D budget is 457.5 billion won ($1.1 billion), a 15 percent increase from the previous year. It plans to accelerate R&D-related spending to over four percent of GDP by 1998 and to five percent by the year 2000. (Total U.S. public and private sector R&D is presently about 2.4 percent of GDP.)

The Korean private sector has also increased its R&D investment by about 20 percent annually, aided in large part by government incentive programs. The chaebols (large industrial conglomerates) dominate private R&D, and are expanding and modernizing their facilities. As a result, total Korean R&D expenditures jumped from $418 million in 1981 to over $5.46 billion in 1995, or 2.8 percent of the GDP.

Republic of Korea's
Science & Technology Expenditures
(in current won)



Source: 1995 Korea Industrial Technology Association Annual Report

Korea's Strategic Policy and Infrastructure

The Ministry of Science and Technology (MOST) and the Ministry of Trade, Industry, and Energy (MOTIE) are the primary agencies responsible for science and technology. MOST focuses on basic and fundamental technology development, while MOTIE focuses on industrial technology development. As part of President Kim's "Globalization Plan," the Ministries developed a series of national development plans to promote technology-based industrialization. The Korean government has also increased its commitment to basic science.

◆ Nine industrial sectors are targeted for development, with selection based on existing technology capabilities, international comparative advantage, the country's energy and resource base, growth potential, and social development criteria. They are:

— informatics
— fine chemicals
— biotechnology
— oceanography
— environmental technology
— information technology
— precision machinery
— new materials
— aeronautics

◆ *Highly Advanced National Project (HAN)* identifies and develops strategic industrial technology requiring nationwide R&D investment. The Government invested over $334 million in 1995 in HAN, and will increase its investment by five percent in 1996. Projects include new medicine, agricultural chemicals, next-generation semiconductors, and HDTV. These are core technologies in which Korea has the capacity to compete against the advanced industrialized countries. **MORE**

Korea continued—

- In 1995, the Korean government earmarked $114 million for international R&D projects for developing bio-engineering technology and software technology (including the Global Information Superhighway), and $10 million for other joint international R&D projects. It plans to invest $55 billion by 2015 on its information superhighway.
- Additional areas of high priority include: $62.8 million for specialized research (including medicine) by government-funded research institutes; $10 million for leading-technology development projects (advanced materials, biomaterials, environmental technology, next generation nuclear reactor technologies, etc.); $250 million for the development of multi-purpose satellites and a twin-engine plane; and $5.7 million for critical engineering technology development projects.

INDONESIA, MALAYSIA, THAILAND, AND TAIWAN

Emerging Asian Economies Push to Become Players in Science and Technology

Over the past two decades, Asia's technological infrastructure has grown dramatically in sophistication. The emerging Asian economies all see a link between science, technology, and economic growth. While still primarily importers of technology, they are building indigenous capabilities through foreign investment and extensive workforce and industrial training programs. All are characterized by strong GDP growth rates, increasing levels of R&D investment, and movement towards higher-value added, more technology-intensive industries.

INDONESIA

Indonesia has a long-term record of steady growth. It now has a GDP of $166.1 billion that has been growing at an average rate of 7 percent annually. The Indonesian government has decided that science and technology will play an important role in maintaining the country's economic expansion. R&D spending rose from 0.12 percent of GDP in 1990 to 0.26 percent in 1994.

Indonesian science and technology policy emphasizes industrial development. The policy pays special attention to human resource development, small and medium-sized companies, and technology-intensive industries. And while government institutions still dominate many R&D activities, they are restructuring to be more relevant to industry.

As part of its effort to move from an agrarian to an industrial society, the Indonesian Government plans to invest over $113 billion in the aerospace, telecommunications and energy sectors. Environmental and health care technologies are also priorities. Indonesia is seeking foreign technology and partnerships to speed developments in these areas.

One of the most progressive trends in Indonesia is the use of information technology. Indonesia's 13,000 islands stretch 3,300 miles east to west, and 1,300 north to south, posing a formidable information technology challenge. Microwave transmission has bridged this distance and become the backbone of the Indonesian telecommunication system, serving as the long distance link within the islands. Indonesia expects to invest over $73 million within the next year in building its information infrastructure.

MALAYSIA

Malaysia is one of the top high-tech performers among the South East Asian economies. Its economy is booming. Its GDP growth rate averaged 8.7 percent from 1989 and 1993. As the economy continues to grow, so does the consumer base and its purchasing power. Per capita GDP reached $3,500 per person in 1994. Gross domestic expenditures on R&D reached approximately $214.9 million in 1994, or 0.37 percent of GDP.

Because of its high economic growth and industrialization, Malaysia has grown from primarily a commodity exporter to an exporter of many electronic products and is now the world's third largest producer of semiconductor chips. Its growing economy, skilled workforce, overall business environment, political stability and the presence of major multinational electronics firms continue to attract high-tech investment and technological cooperation.

The *Second Outline Perspective Plan* and *Vision 2020* recognize the importance of science and technology to the country's industrialization efforts and its global competitiveness. Also, under the *Sixth Malaysia Plan* (1990-1995), the government allocated RM 600 million ($234 million) for R&D activities under the *Intensification of Research for Priority Areas (IRPA) Programme*. The *Seventh Malaysia Plan* (1996-2000) will institute a competitive bidding process for R&D projects and try to ensure that projects are more relevant to industry. Malaysia has already invested over $90 million in environmental technologies; health care technology is another priority area for government spending.

In its efforts to be fully "industrialized" by the year 2020, the Malaysian government plans to spend at least $2 billion annually on improving its telecommunications infrastructure. Malaysia's information technology market has evolved into one that demands sophisticated technology.

TAIWAN

Taiwan is likely to continue improving its competitiveness as one of Asia's new competitors in advanced technologies. GDP grew at an average annual rate of 6.5 percent during the 1989-1993 period, with GDP in 1994 reaching 6,459 million won ($244 billion). Governmental spending on science and technology is approximately 1.82% of its GDP and rising.

Taiwan has a solid record of investment in science and technology infrastructure, and in turning technology into products for export (especially in microelectronics infrastructure). For example, Taiwanese authorities and industry have built Hsinchu Science Park into one of Asia's foremost sci-

MORE →

ence and technology parks. It hosts 173 small entrepreneurial companies that primarily produce integrated circuits, personal computers and computer peripherals. In the first half of l995, they generated $5 billion in sales.

Its infrastructure for science and technology research combines the skills of scientists in academia and quasi-governmental research labs. Universities perform basic research, and often concentrate on a single specialty. Tsinghua University concentrates on nuclear technologies, National Polytechnic University has the lead on electronics, and Central University specializes in atmospheric research. These universities coordinate with the Industrial Technology Research Institute (ITRI) to commercialize technology which ITRI believes is viable in the domestic market.

ITRI is a non-governmental, publicly funded organization that bridges the gap between basic governmental research and private industry. Since l972, ITRI has performed industrial research, developed new industrial products and production methods, and transfered research results to the marketplace. It also coordinate Taiwan's research entities, analyzes industrial development, conducts and reviews feasibility studies for new industrial technologies, and collects foreign scientific and technology information. ITRI organizes its research centers according to scientific discipline. They are:

- Electronics Research and Service Organization (ERSO)
- Opto-electronics and Systems Laboratories (OES)
- Computer/Communication Research Laboratories (CCL)
- Union Chemical Laboratories (UCL)
- Energy and Resources Laboratories (ERL)
- Mechanical Industry Research Laboratories (MIRL)
- Materials Research Laboratories (MRL)
- Center for Measurement Standards (CMS)
- Center for Pollution Control Technology (CPCT)
- Center for Aviation and Space Technology (CAST)
- Center for Industrial Safety and Health Technology (CISH)

ITRI receives funding from the government to establish an environment for basic research, implement national applied research projects, and assist small and medium sized businesses. It also receives funds from industry to execute joint development and contract projects for technical services, and to disseminate technical information. The Industrial Technology Investment Corporation, a part of ITRI, commercializes the research.

Thailand

Thailand's outward-looking, market-oriented economic policies encourage foreign direct investment as a means of promoting economic development, employment and technology transfer. The success of these policies has allowed Thailand to enjoy annual economic growth rates averaging nearly 10 percent from 1983 to 1993.

In concert with increases in economic growth, the 1993-1995 Thai science and technology budget rose to 5,289 million bath ($210 million) or 0.15 percent of GNP in 1995. The Ministry of Science, Technology and Industry is developing the Eighth Five Year Plan which will start in 1997. This plan stresses scientific and technical workforce development, technology transfer, research and development, and building the science and technology infrastructure. Thailand is still developing its infrastructure and will continue to rely on foreign direct investment, R&D, and technology attracted by the country's low labor costs and open markets.

Thailand's rapid growth has caused infrastructure bottlenecks, environmental degradation, and shortages of skilled personnel. Thailand will spend more than $100 billion in the 1995-2000 period on infrastructure and workforce development. Thailand's Ministry of Science, Technology, and Environment (MOSTE) had established an environmental fund with a projected annual budget of $80 million through 1996. Also, MOSTE has set up the *"Revolving Fund for Technology Research and Development and Technology Development Fund"* to encourage private sector R&D and improve production processes. It also provides technical support and technical services such as testing and quality control for companies. In addition, companies can deduct 150 percent of actual R&D expenses from taxable income.

CANADA

Canada Maintains Support for Technology Despite Budget Resolutions

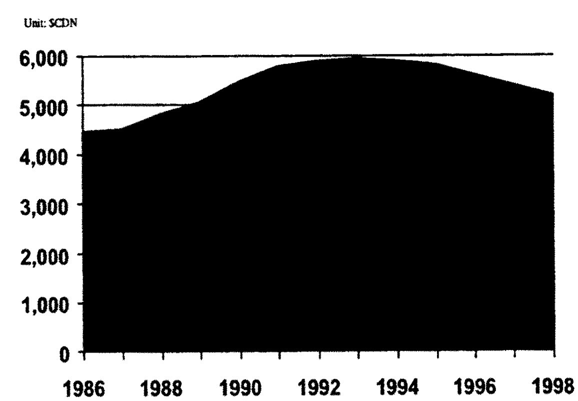
The Canadian government regards science and technology as key engines of economic growth. Canada concentrates on activities that foster innovation, rapid commercialization, and value-added production to stimulate technology-based growth and manage technological change. It also helps counter the strong backing foreign competitors receive from their own governments. As part of this effort, Canada announced a new program in March 1996 — *Technology Partnerships Canada* — to encourage technological innovation over the next three years.

The Canadian government now invests $4.2 billion U.S. dollars in science and technology annually. From fiscal year 1986-87 to 1993-94, federal investments in science and technology increased at an average rate of 6 percent per year. However, in the February 1995 federal budget, Canada announced it was decreasing its investments by 10 percent over three years (a decrease of $425 million U.S. dollars by fiscal year 1998-99) as part of its commitment to reduce the overall government deficit to 2 percent of GDP in fiscal year 1997-98. Despite this reduction, Canada maintains its strong commitment to technology development.

TECHNOLOGY DEVELOPMENT

→ In the March 6, 1996 federal budget, Canada supplemented its investments in *Technology Partnerships Canada (TPC)* by reallocating $200 million U.S. dollars from overall budget savings. TPC will leverage investment in higher technology products and processes, and encourage their commercialization through partnerships and risk-sharing with the private sector. By 1998, the TPC annual budget is expected to grow to $180 million U.S.dollars.

Canada's S&T Expenditures
1986-1998
(in current Canadian dollars)



Note: S&T Expenditures consist of expenditures for R&D and RSA.
Source: Industry Canada 1994/1995

→ Aerospace is a principal focus of TPC. The Canadian government intends to maintain jobs in this sector, which faces heavily subsidized foreign competition.

→ TPC will also assist defense conversion, encourage the development of environment technologies, and stimulate development of new "enabling technologies" such as advanced manufacturing, materials technologies and biotechnology. TPC is part of a broader government-wide technology effort to promote the diffusion of technology within the economy by assisting the private sector in developing new products and processes, improving productivity, enhancing competitiveness and growth, and creating jobs. New initiatives include *School Net*, *the Community Access Program*, *Canadian Technology Network* and *Strategies* (the largest Canadian business information site on the World-Wide Web).

→ Finally, TPC supplements federal tax incentives for scientific research and experimental development. In recent years, the value of these tax credits has exceeded $730 million U.S. dollars annually, which results in a total federal science and technology commitment of about $5 billion U.S. dollars for fiscal year 1995-96.

Canada reallocates $200 million U.S. dollars in budget savings to encourage technological innovation.